(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 979 711 A2

# (12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
**16.02.2000 Bulletin 2000/07**

(51) Int Cl.[7]: **B27B 9/02**

(21) Application number: **99306356.9**

(22) Date of filing: **11.08.1999**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE**
Designated Extension States:
**AL LT LV MK RO SI**

(30) Priority: **13.08.1998 US 133923**

(71) Applicant: **Black & Decker Inc.**
**Newark Delaware 19711 (US)**

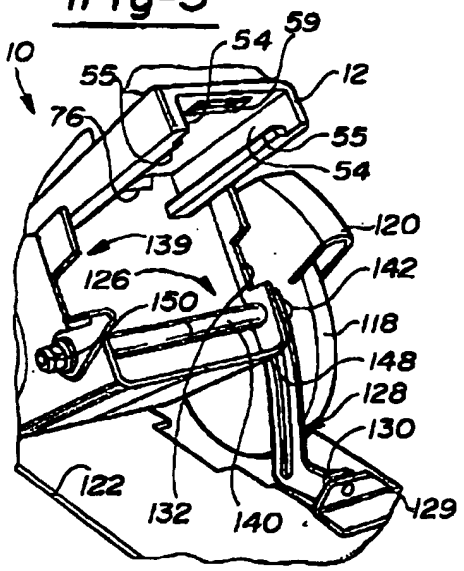
(72) Inventors:
- **Buck, John E.**
**Cockeysville, Maryland 21015 (US)**
- **Bascom, James P.**
**Bel Air, Maryland 21015 (US)**
- **Moore, Keith**
**Owings Mill, Maryland 21117 (US)**

(74) Representative: **Shaya, Darrin Maurice et al**
**Black & Decker Europe,**
**European Group Headquarters,**
**210 Bath Road**
**Slough, Berkshire SL1 3YD (GB)**

## (54) Battery powered portable circular saw with depth of cut control

(57) A battery powered circular saw (10) includes a rechargeable battery (16) removably attached to the housing (12) and an adjustable shoe (122) pivotally attached to a guard assembly for controlling a depth of cut. A locking mechanism (126) for preventing relative movement between the adjustable shoe (122) and the housing (12) includes a depth of cut strap (128) disposed adjacent a first sidewall (132) of the housing (12). A lever (134) is disposed adjacent a second sidewall (136) of the housing (12). A tightening element interconnects the depth of cut strap (128) and the lever (134). The battery powered circular saw (10) additionally includes a handle (110) extending from the housing (12). The handle (110) is disposed substantially parallel to a direction of cut and oriented horizontally above the housing (12). The rechargeable battery (16) includes a pair of laterally spaced apart guide rails (52) which cooperate with the pair of longitudinally extending grooves (54) to permit sliding movement of the rechargeable battery (16) in a direction parallel to the direction of cut.

Fig-3




EP 0 979 711 A2

## Description

**[0001]** The present invention generally pertains to power tools. More particular, the present invention pertains to a battery powered circular saw.

**[0002]** It is now well known to power various tools with rechargeable batteries. For example, commonly assigned U.S. Patent No. 3,757,194 discloses a cordless power tool having a removable battery pack. In the embodiment illustrated, the cordless power tool is a shrub and hedge trimmer powered by a battery pack removably attached to a motor housing. Advantageously over corded tools, such battery powered tools are not limited to use where a power cord can reach an electrical outlet. Moreover, such battery powered tools do not have cords which may inconvenience tool operation or which may be inadvertently severed during tool use.

**[0003]** To a more limited extent, it has been heretofore proposed to power a circular saw with a rechargeable battery. For example, U.S. Patent No. 4,555,849 discloses a portable electric circular saw which operates on a rechargeable battery. The disclosed tool includes a rechargeable battery removably insertable into a laterally extending battery chamber. United States Patent No. 4,955,849 fails to disclose any mechanism for locking the base relative to the housing at a desired depth of cut.

**[0004]** While prior efforts to power a circular saw with a removable battery may have attained limited success, they have all been associated with disadvantages. For example, packaging restrictions are significant due to the size of rechargeable batteries required for powering a circular saw. In this regard, incorporation of commercially desirable features such as a readily accessible locking mechanism for locking an adjustable base or shoe relative to a housing for establishing a desired depth of cut has been curtailed in prior known arrangements. Many circular saws have a depth of cut lever located at the rear of the saw, directly adjacent to the blade guard. between the guard and the handle in the top view. Easy access to this area when releasing or locking the lever can be difficult. Some corded saws have moved this control to a more convenient location at the left rear side of the saw so that it is between the user and the saw's handle. On known cordless circular saws, the location of the battery restricts access and ability to use this area. It is also desirable to further ergonomically improve battery powered circular saws.

**[0005]** According to one aspect of the present invention, there is provided a battery powered circular saw characterized by: a housing having first and second laterally spaced sidewalls; a motor and gear train disposed in the housing for driving a blade; a handle extending from said housing; a rechargeable battery removably attached to said housing directly below said handle; an adjustable shoe pivotally attached to said housing for controlling a depth of cut; and a locking mechanism for preventing relative movement between said adjustable shoe and said housing, said locking mechanism includes a depth of cut strap disposed adjacent said first sidewall, a lever disposed adjacent said second sidewall and a connector element interconnecting said depth of cut strap and said lever such that rotation of said lever arrests movement of said strap relative to said housing.

**[0006]** The connector element preferably passes through an opening disposed between the motor/gear box area of the housing and the rechargeable battery. The connector element may comprises a threaded through bolt. A sleeve is preferably disposed between the connector element and the boss portion and the first and second sidewalls. The bolt may include a non-circular portion slidably received within an elongated groove of said depth of cut strap to prevent relative rotation and enable tightening of the bolt in a nut fixed to the lever.

**[0007]** According to a second aspect of the present invention, there is provided a battery powered circular saw characterized by: a housing; a motor and gear train disposed in the housing for driving a circular saw blade attached to said housing for rotation about a pivot axis; a handle extending from said housing, said handle disposed substantially perpendicular to said pivot axis and oriented horizontally above said housing; and a rechargeable battery pack; and means for removably attaching the battery pack to said housing to permit sliding movement of said rechargeable battery pack in a direction perpendicular to said pivot axis.

**[0008]** The means for releasably attaching the pack in the housing preferably comprises (1) a pair of longitudinally extending grooves formed on the housing and (2) a pair of laterally spaced apart guide rails formed on the battery pack for cooperating with said pair of longitudinally extending grooves. Other attachment means may also be used. The grooves preferably extend substantially parallel to said handle.

**[0009]** The saw may further include a shoe attached to said housing. The rechargeable battery may be positioned between said handle and said shoe when said rechargeable battery is fully attached to said housing.

**[0010]** The handle may have a generally inverted V-shape. The rechargeable battery pack is preferably laterally centered under said handle when said rechargeable battery pack is fully attached to said housing. A trigger may be carried by said handle and be longitudinally and laterally aligned with the center of gravity of the circular saw to provide good ergonomic balance.

**[0011]** Additional benefits and advantages of the present invention will become apparent to those skilled in the art to which this invention relates from a reading of the subsequent description of the preferred embodiment and the appended claims, taken in conjunction with the accompanying drawings.

**[0012]** The present invention will now be described, by way of example only, and with reference to the accompanying drawings, of which:

**[0013]** Figure 1A is a side view of a battery powered

circular saw constructed in accordance with the teachings of a preferred embodiment of the present invention.

**[0014]** Figure 1B is a front perspective view of the battery powered circular saw of the present invention.

**[0015]** Figure 2 is a rear perspective view of a portion of the battery powered circular saw of the present invention shown as a rechargeable battery pack is being installed.

**[0016]** Figure 3 is rear perspective view of a portion of the battery powered circular saw of the present invention shown with an adjustable shoe rotated to an extended position.

**[0017]** Figure 4 is a vertical cross-sectional view taken through a depth of cut locking mechanism.

**[0018]** Figure 5 is an enlarged and exploded perspective view of the rechargeable battery pack of the battery powered circular saw of the present invention.

**[0019]** Figure 6 is a top view of the rechargeable battery pack.

**[0020]** Figure 7 is a front view of the rechargeable battery pack.

**[0021]** Figure 8 is a left side view of the rechargeable battery pack.

**[0022]** Figure 9 is an enlarged and exploded perspective view of a tool terminal block carried by the battery powered circular saw of the present invention.

**[0023]** Figure 10 is a perspective view of the battery pack terminal block of the rechargeable battery pack.

**[0024]** Figure 11 is a cross-sectional view illustrating the interface between the battery pack and tool.

**[0025]** Referring initially to Figures 1-3 of the drawings, a battery powered circular saw constructed in accordance with the teachings of a preferred embodiment of the present invention is generally identified with reference numeral 10. The circular saw or tool 10 is shown to generally include a housing 56 for accommodating a motor (not shown) and gear train (not shown) for driving a blade 118. The tool further includes a rechargeable battery pack 16 removably attached to the housing 12 in a manner which will be discussed in detail below. It will become apparent below that certain aspects of the present invention may be applied to alternative types of battery powered tools.

**[0026]** One aspect of the present invention is particularly directed to an arrangement for locking the battery powered circular saw 10 at a desired depth of cut. Another aspect of the present invention is particularly directed to an arrangement for such a tool which is ergonomically improved. Before addressing these particular features of the present invention, an understanding of certain aspects of the exemplary tool, including the rechargeable battery pack 16 and the electrical interface between the battery pack 16 and the tool housing 12 is warranted.

**[0027]** With continued reference to Figures 1-3 and additional reference to Figures 5-8, the rechargeable battery pack 16 is illustrated to generally include a housing 22, a battery 24 which in the exemplary embodiment illustrated is a 24 volt nickel-cadmium battery, and a battery pack terminal block 26. The housing 22 is shown to include first and second clam shell halves 28 and 30 which are joined at a longitudinally extending parting line 32. The first and second clam shell halves 28 and 30 of the housing 22 form an upper portion 34 defining a first chamber 36 and a lower portion 38 defining a second chamber 40. The first chamber 36 receives the battery pack terminal block 26, while the second chamber 40 receives the battery 24. In one application, the battery pack housing 22 has an overall length of approximately 11.5 cm, an overall width of approximately 9.5 cm, and an overall height of approximately 9.5 cm.

**[0028]** In the exemplary embodiment, the first and second clam shell halves 28 and 30 of the housing 22 are unitarily constructed from a rigid plastic or other suitable material. The first and second clam shell halves 28 and 30 are joined by thread-forming fasteners 42. The thread-forming fasteners 42 pass through cooperating apertures 44 and screw boss portions 46 integrally formed with the clam shell halves 28 and 30. The fasteners 42 form threads in screw boss portions 46. In the exemplary embodiment illustrated, the first clam shell half 28 of the housing 22 is formed to include a peripheral groove 50 adapted to receive a mating rib (not specifically shown) peripherally extending about the second clam shell half 30.

**[0029]** To facilitate releasable attachment of the battery pack 16 to the tool 10, the upper portion 34 of the housing 22 is formed to include a pair of guide rails 52. The guide rails 52, which will be described further below, are slidably received into cooperating grooves 54 defined by longitudinally extending rails 55. To further facilitate removable attachment of the battery pack 16 to the tool 10, the upper portion 34 of the housing 22 defines a recess 58. The recess 58 is adapted to receive a latch pawl 59 (shown in Figure 3) carried by the housing 56 of the tool 10. The latch pawl 59 is conventional in construction and operation and is spring biased to a downward position so as to engage the recess 58 upon insertion of the rechargeable battery pack 16. Removal of the battery pack 16 is thereby prevented until the spring bias of the latch pawl 59 is overcome through manual operation of a button 61. The button 61 functions in a conventional manner insofar as the present invention is concerned. The mating rails 52 and grooves 54 of the pack 16 and housing 22, respectively form a means for releasably attaching the battery pack in the housing. The mating rails and grooves are the preferred means for attachment but those skilled in the art will recognize that other means can be used for attachment of the pack. For example the housing may contain a cavity for receiving all or a portion of the pack. The mating rails and groooves are preferred as they permit precise guidance and alignment of the pack in the housing.

**[0030]** The battery pack terminal block 26 is illustrated to generally include a main body portion 60 constructed of rigid plastic or other suitable material and a plurality

of terminals 62. The terminals 62 are generally planar-shaped blade terminals each oriented in a plane substantially perpendicular to a floor 64 (shown in Fig. 5) partially defining the upper chamber 36 of the housing 22. Each blade terminal 62 includes a first end 66 which downwardly extends from the main body portion 60 and is electrically connected with the battery 24 in a conventional manner. The blade terminals 62 further include a second end 62 which forwardly extends. In the preferred embodiment, the second ends 68 of the blade terminals 62 are upwardly spaced from the floor 62.

**[0031]** The main body 60 of the terminal block 26 is shown captured between the clam shell halves 28 and 30 of the housing 20. This arrangement improves assembly by allowing the terminal block 26 to first be electrically attached to the battery 24 and subsequently captured between the clam shell halves 28 and 30. The main body 60 is shown to include a pair of arcuate grooves 70 provided in a bottom side thereof for accommodating the screw boss portions 46 of the housing 20 upon assembly. Similarly, an upper side of the main body 60 includes a recess 72 for accommodating the recess 58 of the housing 20. The main body portion 60 is further shown to include a plurality of insulating portions 74 interdisposed between adjacent blade terminal 62 and also positioned outboard of each of the outermost blade terminals 62.

**[0032]** In the exemplary embodiment illustrated, the battery pack terminal block 26 includes four blade terminals 62. Two of the blade terminals 62 are the positive and negative terminals for the battery 24. A third terminal 62 may he used to monitor temperature of the battery 24 and a fourth terminal may be used for battery identification. The particular functions of the third and fourth blade terminals 62 are beyond the scope of the present invention.

**[0033]** With particular reference now to Figures 9 and 11, a terminal block 76 carried by the tool 10 is illustrated to generally include a main body portion 80. a first or negative terminal member 82, and a second or positive terminal members 84. The first terminal member 82 includes a negative male terminal 86 and a negative female terminal 88. Similarly, the second terminal member 84 includes a positive male terminal 90 and a positive female terminal 92. As will be further discussed below, the female terminals 88 and 92 are adapted to receive the positive and negative blade terminals 62 of the battery pack terminal block 26. The male terminals 86 and 90 are adapted to electrically attach the tool 10 to a charger (not shown). As shown in Figure 11, when the battery pack 16 is operatively attached to the tool 10, the male terminals 86 and 90 of the tool terminal block 76 are received within apertures 96 provided in each of the rails 52. It will be understood that the male terminals 86 and 90 serve no electrical function when the battery pack 16 is attached to the tool 10.

**[0034]** As shown particularly in the cross-sectional view of Figure 11, the main body 80 of the tool terminal block 76 includes a plurality of window frames 98 which each define a window or opening 100 for receiving and guiding one of the blade terminals 62. The female terminals 88 and 92 of the tool terminal block 76 are disposed within adjacent ones of the window frames 98. The window frames 98 each include a pair of longitudinally extending legs 102. Openings 104 are provided between adjacent window frames 98 for receiving the insulating portions 74. The ends of each of the legs 102 of the frames 98 are generally triangular in shape so as to define lead-in surfaces for the insulating portions 74 into the openings 104 and also for the terminal blades 62 into their respective opening 100. The battery powered circular saw 10 of the present invention is shown to further include a longitudinally extending handle 110. The handle 110 includes a generally V-shaped member having a centrally located apex 111. A rear leg 112 of the handle 110 serves as a first or rear gripping portion. A second gripping portion 114 forwardly extends from a forward leg 115 of the V-shaped member. The second gripping portion 114 is generally cylindrical and is transversely aligned. The handle 110 carries a trigger 116 for actuating the motor in a conventional manner. The trigger 116 is disposed in an opening 117 adapted to receive an index finger of the tool user. In the embodiment illustrated, the handle 110 is oriented horizontally above the tool housing 56 and generally parallel to a rotatable saw blade 118. The plane in which the saw blade resides defines a direction of cut. The saw blade 118 is partially shielded by a blade guard assembly 120. The guard assembly 120 is illustrated to include a fixed or upper portion 120a and a movable or lower portion 120b.

**[0035]** When the battery pack 16 is completely installed, as shown in Figures 1A and 1B, the battery pack 16 is substantially longitudinally positioned under the handle 110. Further, the battery pack 16 is laterally centered under the handle 110 and oriented 90° with respect to a spindle axis of the tool 10. In the preferred embodiment, the center of gravity of the tool 10, including the battery pack 16 is longitudinally and laterally aligned with the trigger 116. The handle 110 effectively bridges the weights of the motor and the battery pack 16 such that a fulcrum or balance point is established in close proximity to the trigger 116. As a result, minimal or no moment arms are presented when the tool 10 is operatively grasped by the user, thereby improving ergonomics of the tool 10.

**[0036]** In the embodiment illustrated, the rails 55 and the grooves 58 defined thereby are oriented parallel to the handle 110. Releasable attachment of the battery pack 16 to the housing 56 is accomplished by first engaging the rails 52 with the grooves 54. Next, the battery pack 16 is translated relative to the housing 16 in a direction parallel to the direction of cut. Gross alignment of the battery pack terminal block 26 with the tool terminal block 76 is obtained through such sliding engagement of the rails 52 of the battery pack 16 with the grooves 54. Fine alignment of the battery pack terminal

block 26 and tool terminal block 76 is provided after the guide rails 52 have advanced substantially along the grooves 54. The battery powered circular saw 10 is further shown to include an adjustable shoe 122 pivotally attached to a forward portion 123 of the guard assembly 120 for rotation about a pivot axis X. As will be appreciated by those skilled in the art, the shoe 122 may be adjusted for controlling the depth of cut. Figures 1A and 1B illustrate the battery powered circular saw 10 with the shoe 122 adjusted to a relatively deep cut. Figure 3 illustrates the battery powered circular saw 10 adjusted to a more shallow cut.

**[0037]** With continued reference to Figures 2 and 3 and additional reference to Figure 4, the battery powered circular saw 10 of the present invention is illustrated to include a locking mechanism 126 for selectively locking the adjustable shoe 122 relative to the housing 56 at a desired depth of cut. The locking mechanism 126 includes a depth of cut strap 128. The depth of cut strap 128 includes a pivoting bracket 129 at its end 130 which is secured to the adjustable shoe 122. The depth of cut strap 128 is arcuate in shape and is disposed between a first side 132 of the housing 56 and the guard assembly 120.

**[0038]** Fixation of the adjustable shoe 122 at a selected depth of cut is controlled by a manual lever 134 disposed adjacent a second side 136 of the housing 56. The lever 134 is carried by a through bolt 138 which passes through a boss-type portion 140 defined by the housing 56. The through bolt is shown extending through an opening or free space provided between the battery 16 and a motor/gear box area 139 of the tool 10.

**[0039]** In the preferred embodiment, a hollow sleeve 142 is positioned between the boss portion 140 and the through bolt 138 to facilitate relative rotation and to ensure that the first side 132, and the second side 136 of the housing 56, cannot be compressed when tightening the manual lever 134. The through bolt 138 has an externally threaded shaft 141 and includes a head 142 carried at a first end 144 of the through bolt 138. A non-circular portion 146 of the through bolt 138 is slidably received within an elongated groove 148 of the strap 128 so as to prevent relative rotation. The lever 114 is fixedly attached to a nut 150. which in turn is threadably received by a second end 152 of shaft 141.

**[0040]** Movement of the lever 134 functions to translate the through bolt 138 toward the nut 150, thereby causing the strap 128 to be drawn against the side 132 of the housing 56. As a result, movement of the strap 128 relative to the housing 56 is arrested and the adjustable shoe 122 is thereby fixed relative to the housing 56 to establish a desired depth of cut.

**[0041]** The present invention provides a number of advantages. The saw according to the preferred embodiment overcomes the disadvantages of prior constructions, including but not limited to the disadvantages discussed in the background of the invention. More specifically, the present invention to provide a depth of cut locking mechanism for a battery powered circular saw which is easy, to access. Further, the present invention provide a battery powered circular saw having a depth of cut locking mechanism including a tightening bolt which passes through the body of the saw forward of the battery, thereby allowing the lever to be conveniently located on the left side of the saw between the user and the saw handle. Finally, the present invention provides a battery powered circular saw which is ergonomically improved by orienting the battery pack under the handle and by locating the trigger switch substantially over the center of gravity of the saw. Other advantages will be apparent to those skilled in the art.

**[0042]** Those skilled in the art will recognize that the present invention can be practiced in accordance with the preferred embodiment and various modifications thereof as are covered by the appended claims.

## Claims

1. A battery powered circular saw 10 characterized by:

   a housing (12) having first and second laterally spaced sidewalls (132, 136);
   a motor and gear train (139) disposed in the housing for driving a blade;
   a handle (110) extending from said housing (12);
   a rechargeable battery (16) removably attached to said housing (12) directly below said handle (110);
   an adjustable shoe (122) pivotally attached to said housing (12) for controlling a depth of cut; and
   a locking mechanism (126) for preventing relative movement between said adjustable shoe (122) and said housing (12), said locking mechanism (126) includes a depth of cut strap (128) disposed adjacent said first sidewall (132), a lever (134) disposed adjacent said second sidewall (136) and a connector element (138) interconnecting said depth of cut strap (128) and said lever (134) such that rotation of said lever (134) arrests movement of said strap (128) relative to said housing (12).

2. The battery powered circular saw of Claim 1, wherein the connector element (138) passes through an opening disposed between the motor and gear train and said rechargeable battery.

3. The battery powered circular saw (10) of Claim 1 or Claim 2, wherein said housing (12) defines a boss portion (140), said connector element (138) passing through said boss portion (140).

4. The battery powdered circular saw (10) of Claim 3,

wherein said connector element (138) comprises a threaded through bolt.

5. The battery powered circular saw (10) according to any one of the preceding claims, further comprising a sleeve (142) disposed between said connector element (138) and said boss portion (140).

6. The battery powered circular saw (10) of Claim 5 when appendant to Claim 4, wherein said through bolt includes a non-circular portion (146) slidably received within an elongated groove (148) of said depth of cut strap (128).

7. A battery powered circular saw characterized by:

a housing (12);
a motor and gear train (139) disposed in the housing for driving a circular saw blade (118) attached to said housing for rotation about a pivot axis;
a handle (110) extending from said housing, said handle disposed substantially perpendicular to said pivot axis and oriented horizontally above said housing; and
a rechargeable battery pack (16); and
means (52, 54) for removably attaching the battery pack to said housing to permit sliding movement of said rechargeable battery pack in a direction perpendicular to said pivot axis.

8. The battery powered saw of Claim 7 wherein the means for releasably attaching comprises:

a pair of longitudinally extending grooves (54) formed on the housing and
a pair of laterally spaced apart guide rails (52) formed on the battery pack for cooperating with said pair of longitudinally extending grooves.

9. The battery powered circular saw of Claim 8, wherein said longitudinally extending grooves extend substantially parallel to said handle.

10. The battery powered circular saw according to any one of Claims 7 - 9, further comprising a shoe (122) attached to said housing, said rechargeable battery positioned between said handle and said shoe when said rechargeable battery is fully attached to said housing.

11. The battery powered circular saw according to any one of Claims 7 - 10, wherein said rechargeable battery pack is positioned below said handle when said rechargeable battery pack is fully attached to said housing.

12. The battery powered circular saw according to any one of Claims 7 - 11, wherein said handle has a generally inverted V-shape.

13. The battery powered circular saw according to any one of Claims 7 - 12, wherein rechargeable battery pack is laterally centered under said handle when said rechargeable battery pack is fully attached to said housing.

14. The battery powered circular saw according to any one of Claims 7 - 13, wherein a trigger (116) is carried by said handle and is longitudinally and laterally aligned with the center of gravity of the circular saw.

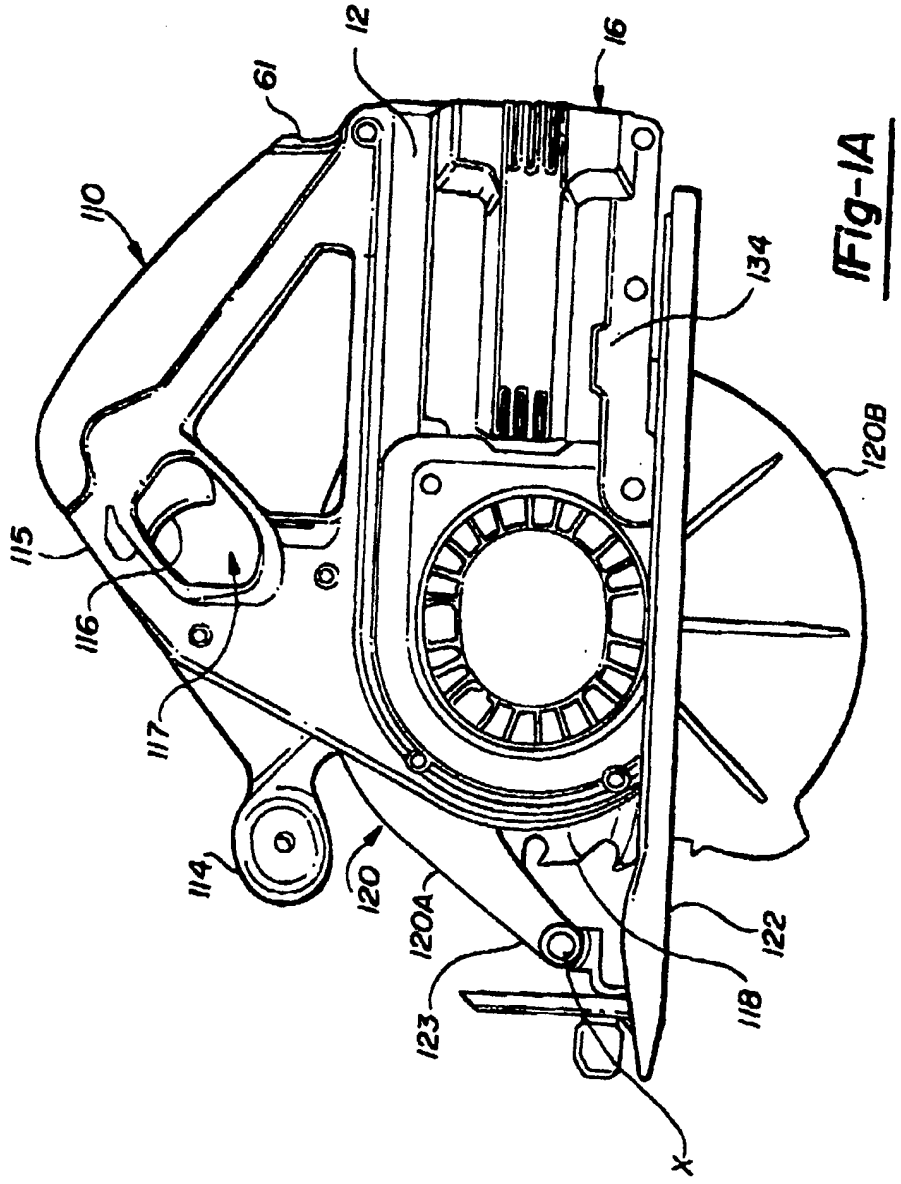



Fig-1A

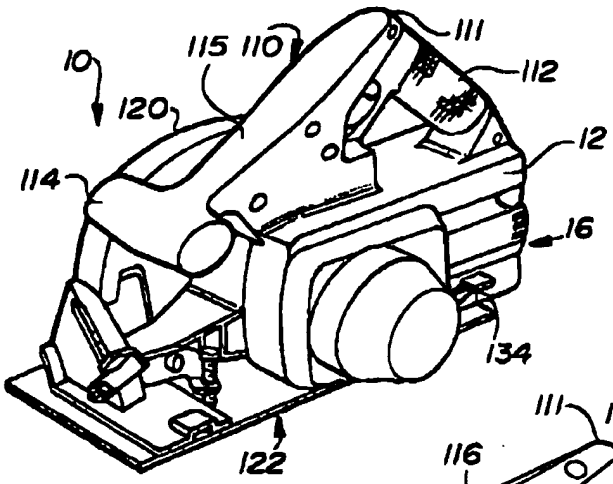



Fig-1B

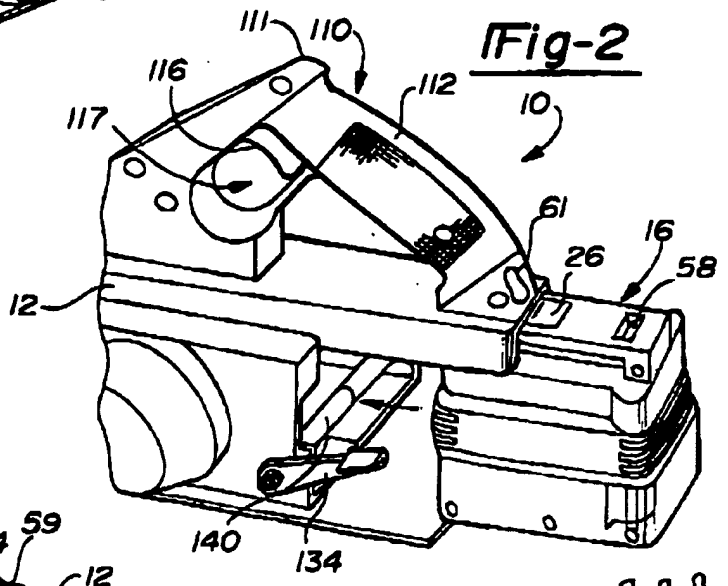



Fig-2

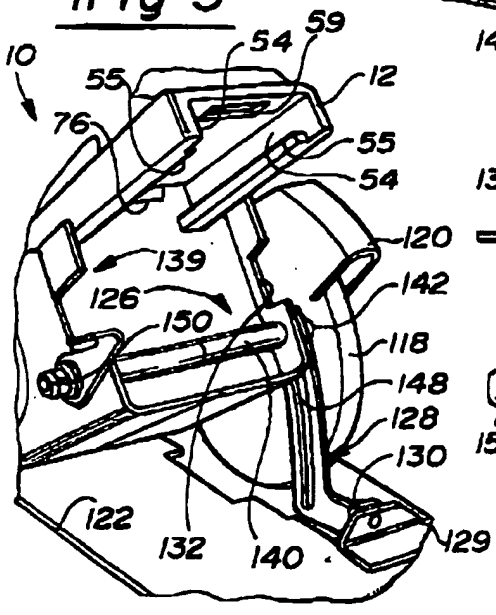



Fig-3

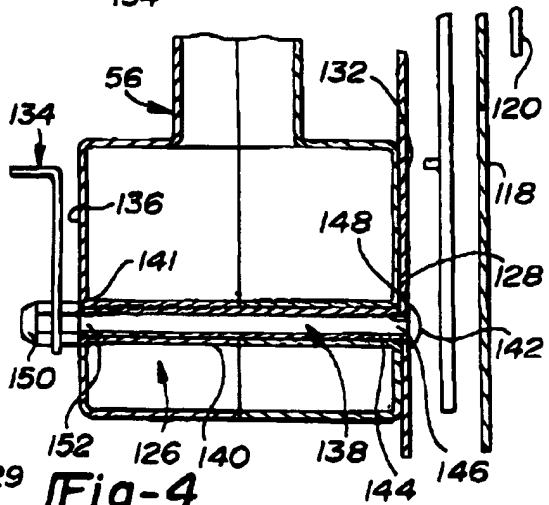



Fig-4

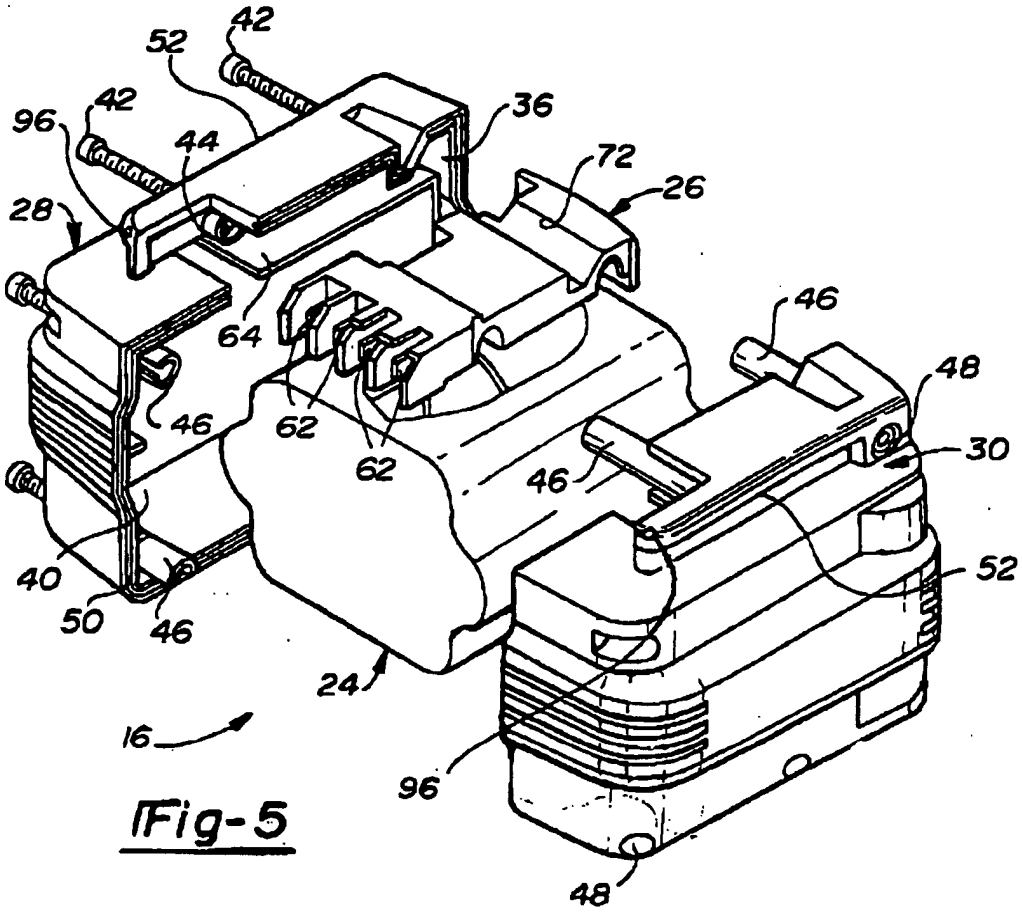

42
52
42
96
44
36
72
26
28
64
46
48
62
62
46
30
46
52
40
50
46
24
16
96
48

Fig-5

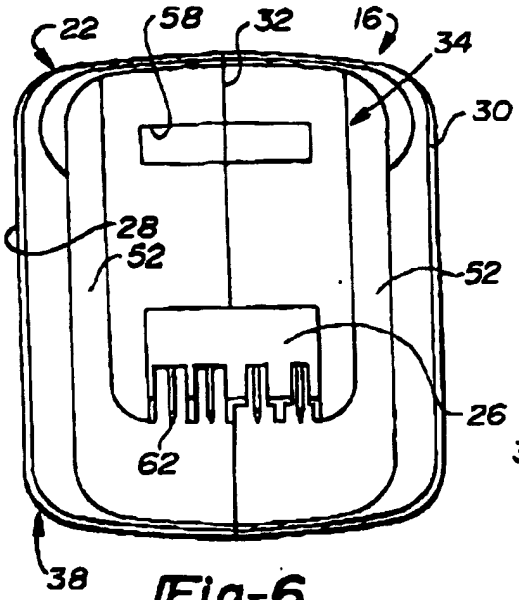



Fig-6

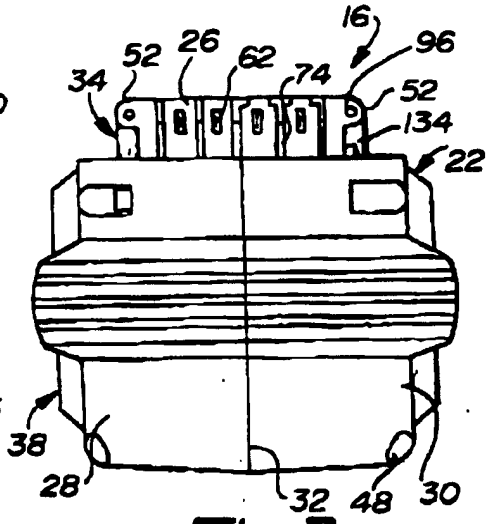



Fig-7

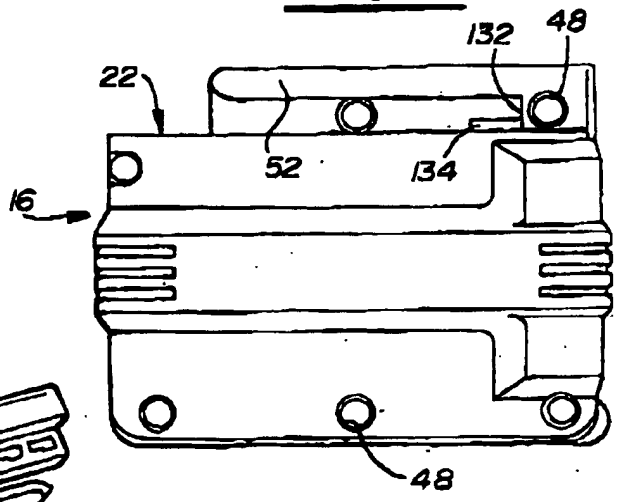



Fig-8

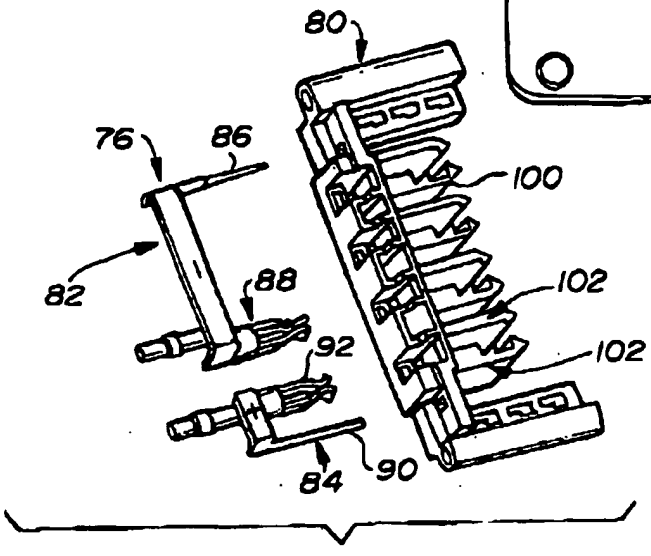



Fig-9

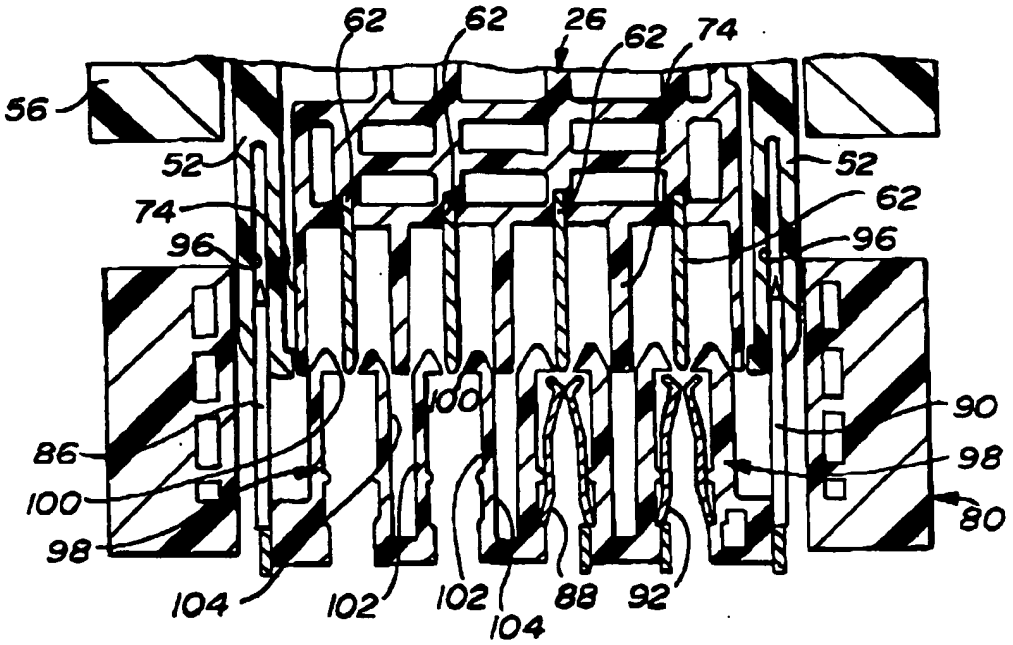

62
62
26
62
74
56
52
52
74
62
96
96
100
90
86
98
100
80
98
104
102
102
104
88
92

Fig-11

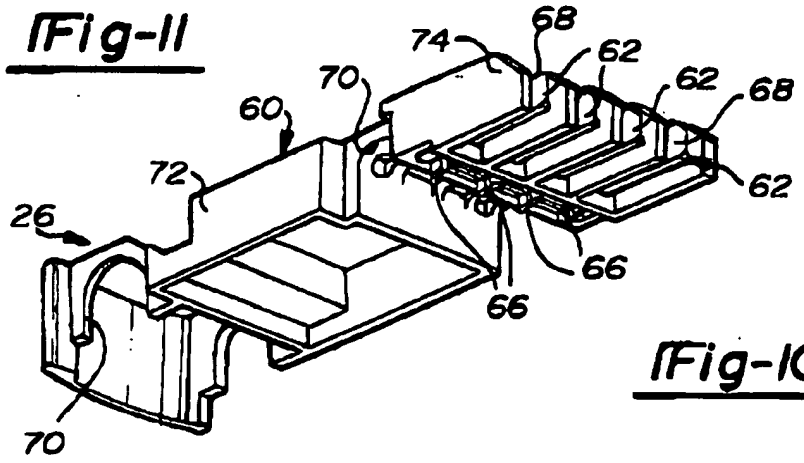

68
74
62
70
62
68
60
72
62
26
66
66
70

Fig-10